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Commentary

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See related research by The Collaborative Study Group on Perioperative $ScvO_2$ Monitoring, http://ccforum.com/content/10/6/R158

## Abstract

Measurements of central venous oxygen saturation ($ScvO_2$) have been successfully used to guide haemodynamic therapy in critical care. The efficacy of this approach in the treatment of severe sepsis and septic shock has stimulated interest in the use of $ScvO_2$ to guide management in patients undergoing major surgery. The physiological basis of $ScvO_2$ measurement is complex. A number of outstanding issues will need to be resolved before incorporating $ScvO_2$ measurement into routine practice. First, it is not yet clear which value of $ScvO_2$ should be targeted. Second, there is some uncertainty as to which interventions are the most effective for achieving the desired value of $ScvO_2$ or how long this value should be maintained. The study by The Collaborative Study Group on Perioperative $ScvO_2$ Monitoring published in this edition of *Critical Care* may help provide answers to some of these questions. Our understanding of $ScvO_2$ measurement remains limited, however, and the routine use of peri-operative $ScvO_2$-guided goal-directed therapy cannot be recommended until a large randomised trial has confirmed the value of this approach.

The use of central venous saturation ($ScvO_2$) to guide haemodynamic management is an important and evolving aspect of clinical practice. An observational study [1] published in this issue of *Critical Care* has advanced our understanding of this form of monitoring by exploring the association between derangements in $ScvO_2$ and complication rates after major abdominal surgery. This study provides a detailed description of peri-operative trends in $ScvO_2$ and confirms the findings of previous work which suggests that reductions in $ScvO_2$ are associated with increased post-operative complication rates [2]. Although the study is relatively small, the robust multicentre approach and consistency with previous work support the applicability of the findings.

The comparative simplicity of $ScvO_2$ measurement makes this an attractive technique. With the blood gas analysis technology available in most institutions, intermittent $ScvO_2$ monitoring can be performed in any patient with a central venous catheter. However, it is not yet clear whether $ScvO_2$ measurement through intermittent blood sampling is an adequate alternative to continuous monitoring with a fibre-optic catheter. Interest in $ScvO_2$ measurement is not new, and several reports have explored the physiology and clinical significance of this parameter over the past 50 years [3]. Of these, the work of Rivers and colleagues [4] has proved the most influential. These authors used a $ScvO_2$ value of 70% as a target for goal-directed haemodynamic therapy (GDT) in patients presenting to hospital with severe sepsis and septic shock. They demonstrated that it may be possible to achieve substantial mortality reductions without the need for complex or invasive cardiac output monitoring technology. The success of Rivers' work and several trials of peri-operative GDT indicates that the use of $ScvO_2$ as a haemodynamic goal may be equally valuable in surgical patients [5-8].

However, several questions must be considered before embarking on an interventional trial of $ScvO_2$-guided peri-operative GDT. First, what treatments should be used to achieve the target value for $ScvO_2$? Second, which target value is most appropriate? Finally, how long should the target value be maintained? The study by the Collaborative Study Group (CSG) is important because it sets out to address some of these key questions. The value of $ScvO_2$ in any given patient reflects not only oxygen delivery but also oxygen consumption. Reductions in $ScvO_2$ may therefore reflect a large number of acute changes in physiology including hypoxia, shivering, anaesthesia, haemorrhage and myocardial ischaemia [3]. The therapeutic approach to achieving the target value may need to include more than simply intravenous fluids and inotropic therapy. If a period of post-operative sedation and invasive ventilation is required to control oxygen consumption, would such an intervention be

CSG = Collaborative Study Group; GDT = goal-directed haemodynamic therapy; $ScvO_2$ = central venous oxygen saturation.

valid? Although the normal value of $ScvO_2$ is often quoted as 70%, there are in fact few published data to confirm this, either in healthy volunteers or in surgical patients [3]. Previous observational work shows that considerable variations in $ScvO_2$ may occur depending on the nature and severity of the acute physiological disturbance. It would be naive simply to accept this 'normal' value as being optimal in every clinical situation.

The CSG researchers explored the relationship between $ScvO_2$ and post-operative complication rates. Their findings suggest that a higher target value of 75% would be more appropriate in patients undergoing major abdominal surgery. This finding is consistent with the analysis of $ScvO_2$ data from a recent interventional trial of post-operative GDT [2]. However, both these studies have shown that large decreases in $ScvO_2$ occur immediately after surgery. It is unclear whether such changes, which are more marked in those patients who develop complications, relate predominantly to an increase in oxygen consumption, a decrease in oxygen delivery or, more probably, a failure to increase delivery to match increased consumption. What is more, these observations raise the possibility that the most appropriate goal for $ScvO_2$ may vary during and after surgery. The question of how long GDT should be continued remains unanswered. Several recent successful GDT trials have opted for short periods of early treatment lasting between 4 and 8 hours [4,6,7]. However, GDT has also been effective when administered for periods of up to 24 hours [5,8].

As with any monitoring technology, $ScvO_2$ is a double-edged sword. Anecdotal evidence suggests that clinicians have a limited understanding of the pitfalls associated with $ScvO_2$ measurement, which may lead to a number of problems in practice. For example, the aggressive targeting of too high a value for $ScvO_2$ may be harmful, particularly in the elderly. The authors make an important point in suggesting that the targeted value for $ScvO_2$ should be modified for different patient groups. In particular, the presence of cytopathic hypoxia in septic patients may result in a high value of $ScvO_2$ despite low oxygen delivery. Another consideration is that of sampling site. Venous oxygen saturation differs between the superior vena cava and the right atrium, and the value of $ScvO_2$ may therefore vary according to the position of the catheter tip [3]. Despite the promising findings of this most recent work, the routine peri-operative use of $ScvO_2$-guided GDT cannot be recommended until a large randomised trial has confirmed the value of this approach.

## Competing interests

The authors declare that they have no competing interests.

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